Sending — 1. Amendment & Response – 21
2. Markup of original CIP 112
3. CIP Replacement 84 4. Drawings 21

OFFICIAL FILING BY FACSIMILE TRANSMISSION ON OCTOBER 3, 2003 TO FACSIMILE #703-872-9318, FOR EXAMINER F. L. EVANS, TELEPHONE 703-308-4805, ART UNIT 2877

Response 21 pages, Markup 112 pages
CIP Replacement Application 84 pages
Drawings 21 sheets
Total Fax 238

Our Ref. No. P-1259-981

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of: OZANICH	Date: October 3, 2003
Serial No. 09/804,613	Group Art Unit: 2877
Filed: March 12, 2001	Examiner: F. L. Evans
For: AN APPARATUS AND METHOD FOR MEASURING AND CORRELATING CHARACTERISTICS OF FRUIT WITH VISIBLE/NEAR INFRA-RED SPECTRUM	

AMENDMENT AND RESPONSE

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Dear Commissioner:

In response to the communication from the Examiner dated June 4, 2003, please consider the following:

Petition for Extension for Response Within the First Month-Fees Due

The applicant respectfully observes that this response is filed within the first month. The Examiner is hereby authorized to deduct $55.00 as fees for filing within the first month and to deduct other fees owing from the deposit account of Liebler, Ivey & Connor, P.S./Floyd E. Ivey, 35,552, Deposit account No. 50-0607.

Certificate of facsimile filing on October 3, 2003 by Floyd E. Ivey. Floyd E. Ivey, USPTO 35552, certifies the filing of this document by facsimile transmission 10/3/03.

Application No. 09/804,613

Received from < 5097353585 > at 10/3/03 6:13:00 PM [Eastern Daylight Time]

The reference measurement, utilizing a shutter means, is demonstrated in Fig. 9. Fig. 9 is an elevation depicting an additional embodiment of the invention demonstrating at least one light detector 80 having at least one output 82 to at least one spectrometer 170 having at least one detector 200. At least one colluminating lens 78 intermediate the at least one light detector 80 and a sample 30. The at least one light detector 80 positioned to detect light from the sample 30. At least one light source 120 lamp 123; a shielding means intermediate the at least one light source 120 lamp 123 and a sample 30 conveyed by sample conveyor 295. At least one aperture 310 in the shielding means to allow illumination of the sample 30 by the at least one light source 120 lamp 123. It will be appreciated by those of ordinary skill in the instrument containment arts that an instrument case or container will be a means of mounting the elements of the disclosed invention in all its embodiments. It will be appreciated that a case 250 may provide shielding and mounting means for the invention. At least one light interruption means intermediate the at least one light source 120 lamp 123 and the at least one aperture 310. Light interruption means provided, for example, by light shutter 300 means. The at least one light shutter 300 operable by at least one shutter control means 305, e.g., linear actuator or rotary solenoid operated by means, e.g., mechanical driven by electrical, pneumatic, hydraulic or other power means or other shutter means including for example liquid crystal screen operated by means. The at least one shutter control means 305 receiving control signals from at least one CPU 172 having at least one shutter operating control output 307. At least one reference light transmitting means 81 including, for example, fiber-optics including bifurcated fiber-optics, receiving reference light output from the at least one light source 120 lamp 123. At least one reference light interruption means, comprised for example of shutter 301, intermediate the at least one light source 120 lamp 123 and the at least one reference light transmitting means 81. The at least one reference light shutter 301 operable by at least one shutter control means 305, e.g., linear actuator or rotary solenoid operated by means, e.g., mechanical driven by electrical, pneumatic, hydraulic or other power

Received from < 5097353585 > at 10/3/03 6:13:00 PM [Eastern Daylight Time]

means or other shutter means including for example liquid crystal screen operated by means. The at least one reference light shutter 301 shutter control means 305 receiving control signals from at least one CPU 172 having at least one shutter operating control output 307. The at least one reference light transmitting means 81 providing an input to the at least one spectrometer 170 detector 200. The at least one CPU 172 providing at least one lamp power output 125 to the at least one light source 120 lamp 123. The at least one spectrometer 170, receiving input from at least one reference light transmitting means 81 having at least one output 82 received as in input to the at least one CPU 172. The spectrometer output 82 capable of A/D conversion to form input to the at least one CPU 172. The at least one spectrometer 170, receiving input from at least one detector output 82 received as in input to the at least one CPU 172. The spectrometer output 82 capable of A/D conversion to form input to the at least one CPU 172. Mounting means to light sources 120 lamps 123, detectors 80, shutters 300, shutter control means 305, reference light transmitting means 81 and case 250. Encoder/pulse generator 330 input to CPU 172 providing sample conveyor 295 movement data. Computer program to operate CPU 172 in data collection and control functions.

A reference measurement of the light source 120 lamp(s) 123 intensity vs. wavelength output can also be obtained using reflecting means 360, as seen in Fig. 11, including but not limited to, for example, mirrors or other reflecting or diffusing material, including roughened aluminum, gold, Spectralon®, Teflon, ground glass, steel. Reflecting means 360 will be positioned to reflect light source 120 lamp 123 light to a detector 80 having an output 82 received by a spectrometer 170 detector 200. A colluminating lens 78 may be positioned intermediate the detector 80 and the light reflected by the reflecting means 360. Reflecting means 360 may be positioned, e.g., inserted via an aperture 310, for example where a case 250 is utilized, when a reference measurement is to be made as dictated by reflecting control means 308 as an output from a CPU 172. The CPU 172, via means, will detect the presence or absence of a sample 30 and, when a sample 30 is absent for "n" time increments or sample conveyor 295 movements will provide a reflecting control

Received from < 5097353585 > at 10/3/03 6:13:00 PM [Eastern Daylight Time]

means 308 control signal to reflecting position means 306, e.g., linear actuator or rotary solenoid operated by means, e.g., mechanical driven by electrical, pneumatic, hydraulic or other power means. The reflecting means 360 capable of being withdrawn as dictated by reflecting control means 308 as an output from the CPU 172 when reference measurement is to be ceased and spectra measurement of a sample 30 resumed.

A light reflecting or diffusing body for obtaining the reference spectrum may also be obtained by mechanical insertion of reference means 430, as seen in Fig. 12 and Fig. 13, in or near the location where actual sample 30 is normally measured, which is between the light source 120 lamp(s) 123 and reference light transmission means 320 leading to the sample spectrometer 170 detector 200(s). Insertion is by insertion means including but not limited to an actuator system 400 capable, upon receiving control signals or means as recognized by those of ordinary skill including control signals or means provided from a CPU 172, of operation of an actuator 410 causing a piston 420 to extend 421 and retract 422 as seen in Fig. 12 and 13. Power, including for example electrical, pneumatic, hydraulic and other means, is provided to operate the actuator by power transmission means 440 as will be appreciated by those of ordinary skill.

A CPU 172, controlled by computer program, is not depicted in Fig. 10, 10A, 11, 12 or 13 as a person of ordinary skill will appreciate such structure from viewing other drawings presented herein.

Achieving whole product measurement (minimizing errors due to localized measurement).

To improve the measurement of the entire product, two or more light sources 120 lamps 123 and/or detection 80 points are used. The product can be measured rolling or not rolling with a rolling measurement generally improving whole product measurement, while a non-rolling measurement provides better accuracy and introduces less spectral noise due to movement.

Received from < 5097353585 > at 10/3/03 6:13:00 PM [Eastern Daylight Time]

As a single fruit or vegetable sample 30 passes by the point of spectrum acquisition, multiple spectra are acquired, each spectrum representing a different measurement location or area on the product.

Optimizing signal-to-noise and accuracy with small and large size product.

One or more means may be used to determine the size or weight of the individual fruit or vegetable sample 30. Means for determining product size includes, but is not limited to 1) a separately determined weight or mass using sensors common to the industry, 2) utilizing the color sorter or defect sorter data (e.g., from camera or CCD images), 3) utilizing other size sensors based on magnetic, inductive, light reflectance or multiple light beam curtains, common to other industries. The relative size of the sample 30 can then be used to adjust the hardware spectrum acquisition parameters or the amount of light (by varying the aperture 310 size) to provide an improved signal-to-noise ratio spectrum for large samples 30 and/or to prevent detector 80 saturation by light for small product sample 30, e.g., detector 80 exposure or integration time can be set for longer time periods for large product samples 30 and for shorter time periods for small product.

Improving accuracy by inspection of multiple individual spectra collected from a single product and removing poor quality or "outlier" spectra. Then, calculating the absorbance spectrum from the raw data collected for dark, reference and sample.

Each individual spectrum from the series of spectra acquired for each individual product sample 30 are then inspected by a computer program or programmed hardware. Poor quality spectra are deleted from this batch of spectra and the remaining spectra are used for constituent or property prediction. The retained spectra of the product are combined with the appropriate reference and dark current measurements to produce an absorbance spectrum as follows:

Absorbance Spectrum = -log10 [(sample intensity spectrum- sample dark current spectrum) / (reference intensity spectrum – reference dark current spectrum)] i.e. the absorbance spectrum is equal to the negative logarithm (base 10) of the ratio of the dark current corrected sample spectrum to the dark current corrected reference spectrum.

Received from < 5097353585 > at 10/3/03 6:13:00 PM [Eastern Daylight Time]

All of the absorbance spectra for each product sample 30 can then be combined to produce a mean or average absorbance spectrum of the product sample. This average absorbance spectra can then be used to compute the component or property of interest based on a previously stored calibration algorithm. Alternatively, each absorbance spectrum can be used individually with a previously stored calibration algorithm to compute multiple results of the component or property of interest for an individual product, followed by determination of the average or mean component or property value computed by summing all of the values and dividing the resultant sum by the number of absorbance spectra used.

Method for measuring samples and importance of linking location on product where visible/NIR data was collected with the same location that will be measured by the laboratory reference technique.

Calibration is performed as follows: 1) Spectra of product sample 30 are measured and absorbance spectra (corrected for reference and dark current) are stored, 2) Standard laboratory measurements (which are often destructive) are made on the product sample 30. Note: it is important to the success of the NIR method that the portion of the sample 30 that is interrogated between the light source(s) 120 lamps 123 and light collection(s) detectors, e.g., light detectors 80, leading to the spectrometer(s) 170 detectors 200 is the same as that portion measured by the standard laboratory technique.

For many sample conveyors 295 that are used for whole fruit and vegetable sorting and packing operations, the product can be transported past the NIR measurement location rolling or not rolling. If absorbance spectra are collected from the product as it is rolling, the exact location of any one measurement (one spectrum) is not usually known, and therefore the entire product (as opposed to one localized spot) must be analyzed for the component or property of interest. If calibration algorithms are constructed in this way (using measurements of rolling product), all of the retained spectra for that individual product are averaged to produce an average absorbance spectrum and the total product component or property is assigned to this one absorbance spectrum.

Received from < 5097353585 > at 10/3/03 6:13:00 PM [Eastern Daylight Time]

Because most fruits and vegetable are heterogeneous and vary in component level with location, it is preferable to develop a calibration model on product sample 30 that is not rolling so that each acquired spectrum is from a known physical location on the product sample 30. Then, laboratory measurements are made on the same portion of product sample 30 that spectra were taken from. When this procedure is used, a whole fruit or vegetable sample 30 may be separated, e.g., cut or sliced, into smaller sub-portions prior to laboratory analysis. These smaller sub-portions each correspond to NIR data collected over the same locations within the product sample 30; the time period of NIR data acquisition can be adjusted to shorter or longer times, corresponding to the measurement of smaller or larger product samples 30, respectively. In this case, each sub-portion of the product sample 30 will have one or more spectra associated with that particular location. The laboratory determined component or property is then assigned to each spectrum or spectra from that particular location.

Mathematical processing is performed on absorbance spectra prior to conducting statistical correlation analysis and calibration model building.

Absorbance spectra are pre-processed using a bin and smooth function. Partial least squares analysis (or variants thereof such as piecewise direct standardization) are then used to relate the processed absorbance spectrum to the assigned component and property values such as Brix, acidity, pH, firmness, color, internal or external disorder severity and type, and eating quality.

Method to minimize the number of samples needed to develop a calibration model.

To minimize the number of calibration samples that are necessary, the following method can be used: 1) spectra are collected on all test samples 30, 2) prior to destructive laboratory measurements, principal components analysis (PCA) is performed on the absorbance spectra, 3) Resultant Score plots from PCA (e.g., Score 1 vs. Score 2, Score 3 vs. Score 4, etc.) are then generated, 4) A subset of the original samples (e.g., 40% of the original number of samples) are selected from the Score

Received from < 5097353585 > at 10/3/03 6:13:00 PM [Eastern Daylight Time]

plots in either a random fashion or by selecting samples that, as a group, yield a similar range, mean and standard deviation of score values compared to the entire group of original samples 30.

Calibration updates are periodically required to maintain measurement accuracy, particularly with agricultural product samples 30 that can vary in composition with growing conditions and variety. Several methods can be used to minimize the efforts of calibration updates. As fruit or vegetable samples 30 are analyzed in a packing and sorting warehouse, their visible/near infrared spectra can be examined by software to determine if the sample qualifies as a potential calibration update sample 30. Good calibration update samples 30 will cover low to high component values and will have Score values that cover the same range as the original sample's 30 Score values.

Received from < 5097353585 > at 10/3/03 6:13:00 PM [Eastern Daylight Time]